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(54) FIELD COIL FOR MOTOR AND METHOD OF PRODUCING SAID FIELD COIL

FELDWICKLUNG FÜR EINEN MOTOR UND VERFAHREN ZU DEREN HERSTELLUNG

BOBINE DE CHAMP POUR MOTEUR ET METHODE DE FABRICATION DE LADITE BOBINE

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Description

TECHNICAL FIELD

This invention is related to a field coil for motors used, for instance, for starter motors.

BACKGROUND ART

Conventionally in the motor used for starters, the space factor of the field coil in the motor was increased as an effective method to downsize the motor.

In this case, a straight planar conductor covered with an insulation film having a sufficient insulation resistance has been used generally. If this straight planar conductor is applied to a field device having four magnetic poles as shown in Fig. 6, the straight planar conductor 20 is wound around a pole core 4 of a stator 3 as shown in Fig. 5, one end 20a of the straight planar conductor 20 is connected to the straight planar conductor wound on the neighboring magnetic pole via a connector bar 8, and the other end 20b is connected to a brush 5.

In the abovementioned conventional straight planar conductor 20, the straight planar conductor is wound on the pole core 4, so the insulation films on the surfaces of the straight planar conductors 20 contact creating a double layer insulation films. This requires the wire winding work. Further, although the withstanding voltage between the straight planar conductors is lower than between the stator 3 and the straight planar conductor 20, the insulation films become excessive between the straight planar conductors. Thus, the problem of decrease in the space factor of the field coil occurs.

Document GB-A-234278 is directed to the same problem as the present invention. It discloses a motor in accordance with the preamble of claim 1 of the present invention, which motor comprises a cylindrical or tubular field ring to which inwardly-projecting pole-pieces are attached. In order to increase the space factor of the motor a field-winding is used, comprising two continuous strips of sheet-metal and of different diameters, which are recessed alternately at opposite edges so that a serpentine form is achieved and which are coiled lengthwise into a substantially cylindrical form with the recesses in radial coincidence in the several layers. Between the turns of the winding a suitable insulation may be provided. This field winding is fitted within and coaxially with the tubular field-ring of a dynamo-electric machine so that said recesses are occupied by pole-pieces.

This invention undertakes the above problems, and aims at providing a field coil that can greatly increase the space factor without requiring winding on a pole core.

DISCLOSURE OF THE INVENTION

To solve the above problem, the motor according to claim 1 of the present invention uses a field coil characterized by an opening formed by elimination of a part of a conductor and passing therethrough a pole core of a stator that provides a magnetic path, and by a spiral slit passing the conductor in the thickness direction and formed around the periphery of the opening.

According to this invention, by arranging the opening formed by eliminating a part of the conductor and the spiral slit, the required field coil for winding can be easily obtained, and the field coil need not be wound around the pole core. As the width of the slit can be set smaller, it need not be made to be excessively wide, and the space factor of the field coil can be greatly improved.

Further, the insulation material is provided in a part of the spiral slit or along the entire slit length. Therefore, even if the slit width is decreased to a minimum, the insulation material in the slit prevents short-circuiting between the coils and the space factor is improved further.

Still furthermore, provided that a plurality of field coils are formed integrally by forming the opening and the spiral slit in plural numbers for one conductor, the field coils for a plurality of magnetic poles can be formed at once. As a result, the space for the connector bar which connects the field coils is not required, and the space factor of the field coil can be improved by that amount. Furthermore, the number of required parts can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a top plan view of a field coil showing an embodiment of this invention;

Figure 2 is a side view showing the state with the coil in Figure 1 mounted on a field device;

Figure 3 is a top plan view of a field coil showing another embodiment of this invention;

Figure 4 is a side view showing the state with the coil in Figure 3 mounted on the field device;

Figure 5 is a top plan view of a conventional field coil;

Figure 6 is a side view showing the state with the conventional coil in Figure 5 mounted on the field device; and

Figure 7 is a side view partly in cross section of a speed reduction gear type starter incorporating the embodiment of this invention.

BEST MODE FOR CARRYING OUT THE INVENTION

This invention will be explained with reference to the embodiments shown in the drawings.

Fig. 1 shows a top view of the field coil 2 before being installed on a motor's stator. The field coil 2 is made of a conductor 1 (e.g., copper plate). In the center of this conductor 1 is a rectangular opening 11 through which

a pole core that functions as a magnetic pole in the stator is passed through, although not shown in Fig. 1. Numeral 12 designates a spiral slit which is machined to cover the outer periphery of the opening 11 of the conductor 1 and which, passing through in the thickness direction, connects the outer circumference of the conductor 1 and the opening 11. Because the conductor 1 is divided by this slit 12, the field coil 2 is formed to have the line width L4. The slit 12 can be machined with mechanical machining, electrical discharge machining, laser beam machining or hydraulic pressure machining.

After machining the slit 12, as shown in Fig. 2, the field coil 2 is bent and formed along the arc shape of an inner circumferential surface 31 of the stator 3 that is a part of the field device, and then epoxy resin is applied to insulate the outer surface of the field coil 2. Then, the field coil 2 is placed on an inner surface 31 of the stator 3 and is engaged with a head 41 of the pole core 4. The base of the field coil 2 is sandwiched and fixed by a pole claw 42.

At this time, the width L2 of the slit 12 is so set that the field coil wires do not contact one another and short-circuit, after assembling the field coil 2 onto the stator 3. The arc length L1 of the field coil 2 is set so that the length is equivalent to one pole core length, and the horizontal length L3 is set to be in approximately the axial length of the armature core of the motor which is not shown.

As methods to insulate the field coil 2, insulation material to insulate the coil wires can be inserted into the slit 12 (e.g., insertion of insulation paper, or application or injection of resin), or the insulation material (e.g., powder) can be applied on the entire surface including the slit 12 of conductor 1, after the slit 12 is machined in the conductor 1. In this case, the width L2 of the slit 12 may be determined by the insulation material to be inserted into the slit.

With the above procedure, as the field coil 2 with the required number of windings can easily be obtained by machining and forming the slit 12 on the conductor 1 and the width L2 of the slit 12 in which the insulation material is laid can be arbitrarily set according to the withstanding voltage between the coil wires of the field coil, the insulation material will not become excessive and the space factor of the field coil 2 will be greatly improved. Furthermore, the wire width L4 of the field coil 2 can be arbitrarily set by the slit 12 so that the conductive current density does not become extremely high.

Furthermore, in the conventional straight planar conductor 20 having the insulation film on the outer circumference as shown in Figs. 5 and 6, the film may peel off and may cause a short-circuiting when wound on the pole core 4 of the stator 3. In this invention, however, the field coil 2 does not require winding, so the insulation material will not be separated during winding.

As is clear from the above explanation, by arranging the opening formed by eliminating the conductor and the spiral slit, the field coil with required winding can be obtained easily and the space factor of the field coil can be improved greatly. Thus, the effect in manufacturing and performance are remarkable for use in motors having relatively few windings and with a large conductor cross section area such as a motor for starter requiring a large rated output in a short-time. To further downsize the starter, this invention provides a great effect in reducing the size of the motor by incorporating the speed reduction gear mechanism as shown in Fig. 7.

Another embodiment of this invention will be explained next. Fig. 3 shows the field coil 2 for two magnetic poles formed with one conductor 1 and formed by arranging one set of slits 12.

Fig. 4 shows the example of using the field coil 2 shown in Fig. 3 for the stator 3 of the field device having four magnetic poles. Two conductors 1 are laid out.

In other words, two conductors 1 are each laid out in the inner surface 31 of the stator 3, engaged with the head of the pole core 4 and fixed to the inner surface 31 by sandwiching the base of the conductor 1 with the pole claw 42. One end 2a of the two field coils 2 formed by one conductor is connected to the stator 3, and the other end 2b of the same is connected to a brush 5. One end of the two field coils 2 formed by the other conductor is connected to a lead wire 7, and the other end of the same is connected to the brush 6.

Therefore, by employing the structure shown in Figs. 3 and 4, the field coil 2 for the two magnetic poles can be formed by one conductor 1 and the connector bar 8 connecting the field coils 2 as shown in Fig. 6 is no longer required. This allows space to be used effectively, and the space factor of the field coil 2 laid out in the stator 3 which forms a part of the field device can be improved further. Furthermore, the motors using this field coil 2 can be remarkably downsized.

In the above embodiments, although each piece of the conductor 1 is laid out in the inner surface direction of the stator 3, multiple pieces of conductor 1 can be overlaid in the inner surface direction of the stator 3.

Furthermore, in this invention, although field coil 2 is formed to follow the arc shape of the inner surface 31 of the stator 3 after slit machining, the slit machining can be performed after the formation. In this case, the slit width L2 can be made narrower and the space factor can be improved greatly.

INDUSTRIAL APPLICABILITY

As described above, the field coil for motors according to the present invention does not require winding the field coil around the magnetic pole and, in particular, can be used as the field device disposed in the starter.

Claims

1. A motor comprising:

a cylindrical stator (3);
a plurality of pole cores (4), each pole core being disposed on a radially inner circumferential surface (31) of said stator, said pole core having a head (41) extending radially inwardly from said stator and a pole claw (42) provided at a radially innermost end of said head with a distance radially from said inner circumferential surface of said stator; and
a plurality of field coils (2),

characterized in that each field coil is disposed around said head and sandwiched radially in a single layer between said inner circumferential surface of said stator and said pole claw, said field coil being made of a single conductor plate (1) having a thickness substantially equal to said distance and formed with an opening (11) for receiving said head therein and a spiral slit (12) around said opening, said opening and said spiral slit passing through said conductor plate in a thickness direction, and said field coil being formed in an arcuate shape in correspondence with said inner circumferential surface of said stator.

2. A motor according to claim 1, wherein:

adjacent two of said field coils for adjacent two of said pole cores are made of said single conductor plate.

3. A method of producing a field coil for a motor, said motor being provided with a cylindrical stator (3) and a pole core (4) having a head (41) extending radially inwardly from said stator and a pole claw (42) provided at a radially innermost end of said head with a distance radially from an inner circumferential surface (31) of said stator, said method comprising the steps of:

shaping a conductive plate (1) in an arcuate form in correspondence with said inner circumferential surface of said stator; and
forming a spiral slit (12) through said conductive plate in a thickness direction to form a spiral field coil (2).

4. A method according to claim 3, wherein:

said forming step includes forming an opening (11) through said conductive plate in said thickness direction at a substantially central portion of said spiral slit, said opening being connected with said spiral slit and surrounded by said spiral slit.

5. A method according to claim 4, further comprising:

disposing said field coil around said head at radially inside said stator, said head being received in said opening and said field coil being sandwiched between said inner circumferential surface of said stator and said pole claw.

6. A method according to any one of claims 3 through 5, wherein:

said conductor is shaped to have a thickness substantially equal to said distance.

7. A method according to claim 6, further comprising the step of:

filling said spiral slit by an insulating material after forming said spiral slit and said opening and before disposing said field coil.

8. A method according to any one of claims 4 through 7, wherein:

said forming step forms said opening and said spiral slit at two locations of said conductive plate.

Patentansprüche

1. Motor mit:

einem zylindrischen Stator (3);
einer Vielzahl von Polkernen (4), die jeweils an einer radial inneren Umfangsfläche (31) des Stators angeordnet sind sowie jeweils einen sich vom Stator radial nach innen erstreckenden Kopf (41) und eine in radialer Richtung in einem Abstand von der inneren Umfangsfläche des Stators an dem in radialer Richtung innersten Ende des Kopfs vorgesehene Polklaue (42) aufweisen; und
einer Vielzahl von Feldspulen (2); dadurch gekennzeichnet, daß
jede Feldspule um den Kopf herum und in radialer Richtung in einer einzigen Schicht zwischen der inneren Umfangsfläche des Stators und der Polklaue angeordnet ist, jede Feldspule aus einer einzigen Leiterplatte (1) ausgebildet ist, die eine Dicke hat, die im wesentlichen dem Abstand gleich ist, sowie mit einer Öffnung (11) zur Aufnahme des Kopfs und einem Spiralschlitz (12) um die Öffnung herum versehen ist, wobei die Öffnung und der Spiralschlitz in Dickenrichtung durch die Leiterplatte gehen, und jede Feldspule der inneren Umfangsfläche des Stators entsprechend bogenförmig geformt ist.

2. Motor nach Anspruch 1, wobei:

   zwei aneinander angrenzende Feldspulen für zwei aneinander angrenzende Polkerne aus der einzigen Leiterplatte ausgebildet sind.

3. Verfahren zur Herstellung einer Feldspule für einen Motor, der mit einem zylindrischen Stator (3) und einem Polkern (4) versehen ist, welcher einen sich in radialer Richtung vom Stator nach innen erstrekkenden Kopf (41) und eine in radialer Richtung in einem Abstand von einer inneren Umfangsfläche (31) des Stators an dem in radialer Richtung innersten Ende des Kopfs vorgesehene Polklaue (42) hat, mit folgenden Schritten:

   Formen einer Leiterplatte (1) in Bogenform entsprechend der inneren Umfangsfläche des Stators; und
   Ausbilden eines Spiralschlitzes (12) in Dickenrichtung durch die Leiterplatte in der Weise, daß eine spiralförmige Feldspule (2) entsteht.

4. Verfahren nach Anspruch 3, wobei:

   der Ausbildeschritt das Ausbilden einer Öffnung (11) in Dickenrichtung durch die Leiterplatte in einem im wesentlichen zentralen Abschnitt des Spiralschlitzes beinhaltet, wobei die Öffnung mit dem Spiralschlitz in Verbindung steht und von diesem umgeben wird.

5. Verfahren nach Anspruch 4, mit dem weiteren Schritt:

   Anordnen der Feldspule um den Kopf herum an der in radialer Richtung inneren Umfangsfläche des Stators, wobei der Kopf in der Öffnung aufgenommen ist und die Feldspule zwischen der inneren Umfangsfläche des Stators und der Polklaue angeordnet ist.

6. Verfahren nach einem der Ansprüche 3 bis 5, wobei:

   der Leiter so geformt wird, daß er eine Dicke hat, die im wesentlichen dem Abstand gleich ist.

7. Verfahren nach Anspruch 6, mit dem weiteren Schritt:

   Füllen des Spiralschlitzes mit einem Isoliermaterial nach dem Ausbilden des Spiralschlitzes und der Öffnung und vor der Anordnung der Feldspule.

8. Verfahren nach einem der Ansprüche 4 bis 7, wobei: der Ausbildeschritt das Ausbilden der Öffnung und des Spiralschlitzes jeweils an zwei Stellen der Leiterplatte beinhaltet.

Revendications

1. Un moteur comportant :

   un stator cylindrique (3);
   une pluralité de noyaux polaires (4), chaque noyau polaire étant disposé sur une surface circonférentielle radialement interne (31) dudit stator, ledit noyau polaire comportant une tête (41) s'étendant radialement vers l'intérieur à partir dudit stator et une pince polaire (42) prévue au niveau d'une extrémité la plus interne radialement de ladite tête avec une distance radialement à partir de ladite surface circonférentielle interne dudit stator; et
   une pluralité de bobines de champ (2),

   caractérisé en ce que chaque bobine de champ est disposée autour de ladite tête et prise en sandwich radialement dans une couche unique entre ladite surface circonférentielle interne dudit stator et ladite pince polaire, ladite bobine de champ étant faite d'une plaque de conducteur unique (1) comportant une épaisseur essentiellement égale à ladite distance et formée avec une ouverture (11) pour y recevoir ladite tête et une fente en spirale (12) autour de ladite ouverture, ladite ouverture et ladite fente en spirale passant au travers de ladite plaque de conducteur dans une direction d'épaisseur, et ladite bobine de champ étant formée dans une forme arquée en correspondance avec ladite surface circonférentielle interne dudit stator.

2. Un moteur selon la revendication 1, dans lequel :

   deux bobines de champ adjacentes desdites bobines de champ pour deux bobines adjacentes desdits noyaux polaires sont faites de ladite même plaque conductrice.

3. Méthode de production d'une bobine de champ pour un moteur, ledit moteur étant prévu avec un stator cylindrique (3) et un noyau polaire (4) comportant une tête. (41) s'étendant radialement vers l'intérieur à partir dudit stator et une clé de pôle (42) prévue au niveau d'une extrémité la plus interne radialement de ladite tête avec une distance radialement à partir d'une surface circonférentielle interne (31) dudit stator, ladite méthode comportant les étapes de :

   réalisation d'une plaque conductrice (1) sous une forme arquée en correspondance avec la-

dite surface circonférentielle interne dudit stator; et
formation d'une fente en spirale (12) au travers de ladite plaque conductrice dans une direction d'épaisseur pour former une bobine de champ en spirale (2).

4. Une méthode selon la revendication 3 dans laquelle :

ladite étape de formation comporte la formation d'une ouverture (11) au travers de ladite plaque conductrice dans ladite direction d'épaisseur au niveau d'une portion substantiellement centrale de ladite fente en spirale, ladite ouverture étant connectée avec ladite fente en spirale et entourée par ladite fente en spirale.

5. Une méthode selon la revendication 4 comportant en outre :

la disposition de ladite bobine de champ autour de ladite tête radialement à l'intérieur dudit stator, ladite tête étant reçue dans ladite ouverture et ladite bobine de champ étant prise en sandwich entre ladite surface circonférentielle interne dudit stator et ladite pince polaire.

6. Une méthode selon l'une quelconque des revendications 3 à 5, dans laquelle :

ledit conducteur est formé pour avoir une épaisseur substantiellement égale à ladite distance.

7. Une méthode selon la revendication 6, comportant en outre l'étape de :

remplissage de ladite fente en spirale par un matériau d'isolation après la formation de ladite fente en spirale et ladite ouverture, et avant la disposition de ladite bobine de champ.

8. Une méthode selon l'une quelconque des revendications 4 à 7, dans laquelle :

ladite étape de formation forme ladite ouverture et ladite fente en spirale au niveau de deux endroits de ladite plaque conductrice.

FIG. 1

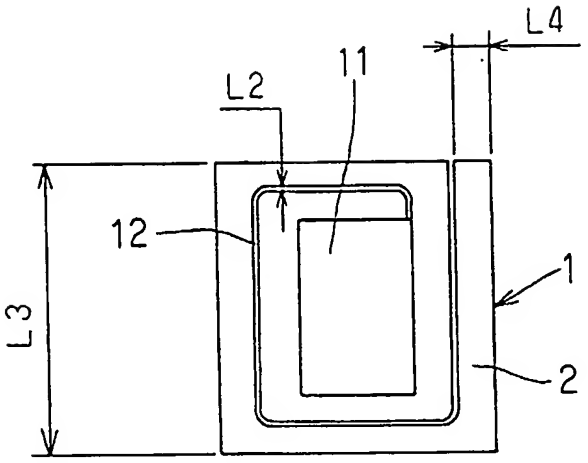


FIG. 2

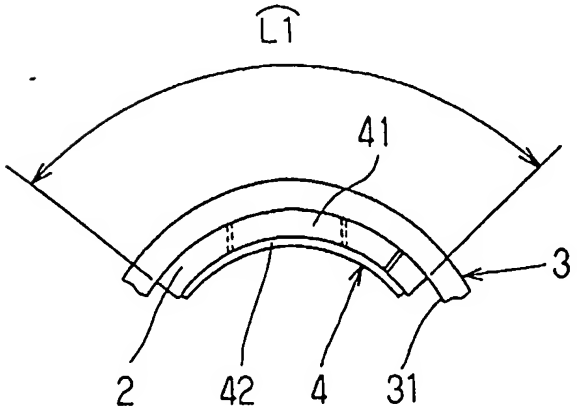


FIG. 3

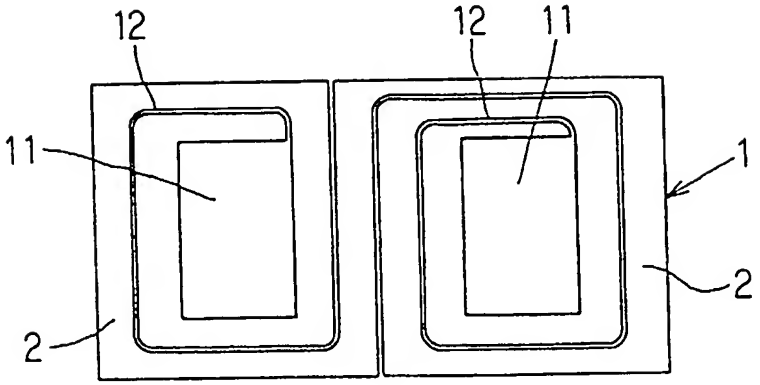


FIG. 4

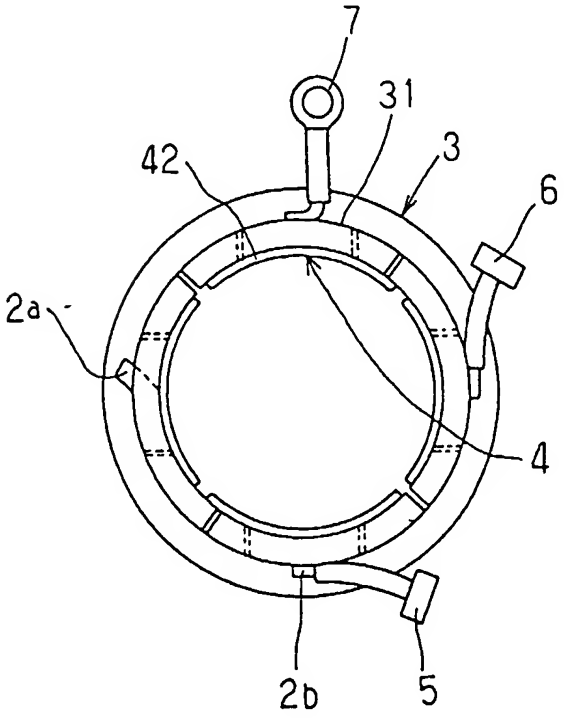


FIG. 5 PRIOR ART

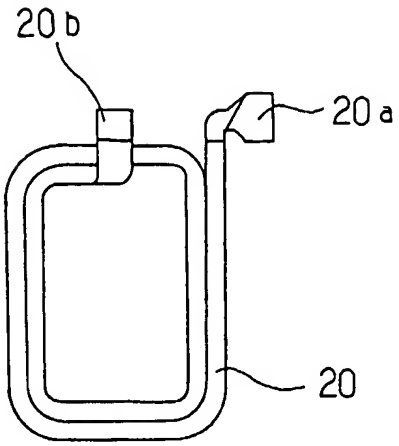
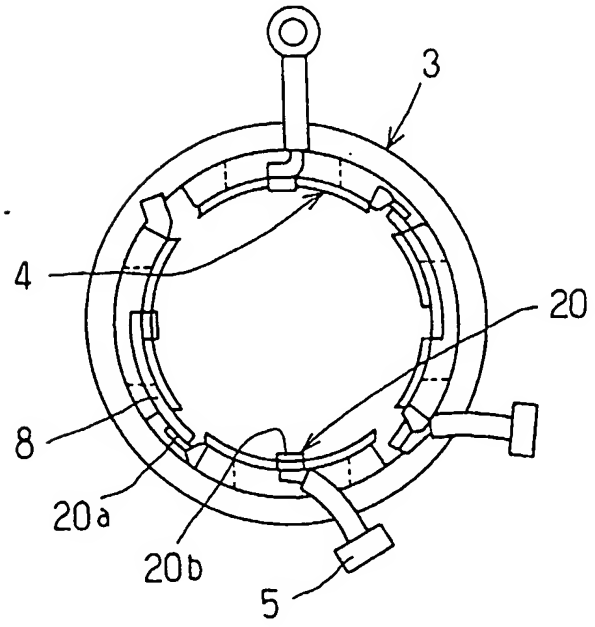


FIG. 6 PRIOR ART



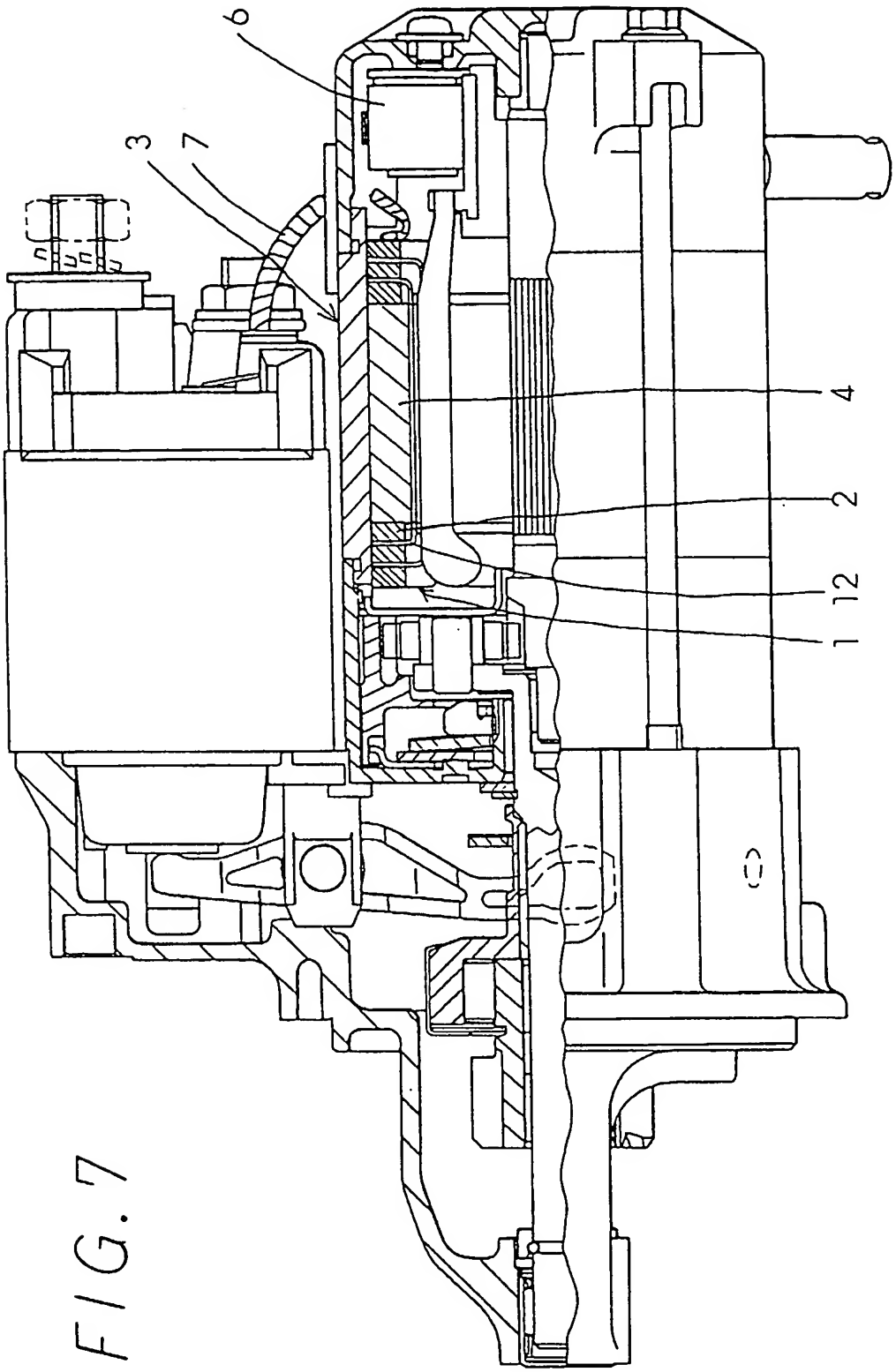


FIG. 7